AM 211/A 211
OPERATOR'S MANUAL

MP MASTER
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ANDERSON JACOBSON, INC.

ANDERSON JACOBSON

AM 211/A 211
OPERATOR'S MANUAL

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1 GENERAL DESCRIPTION

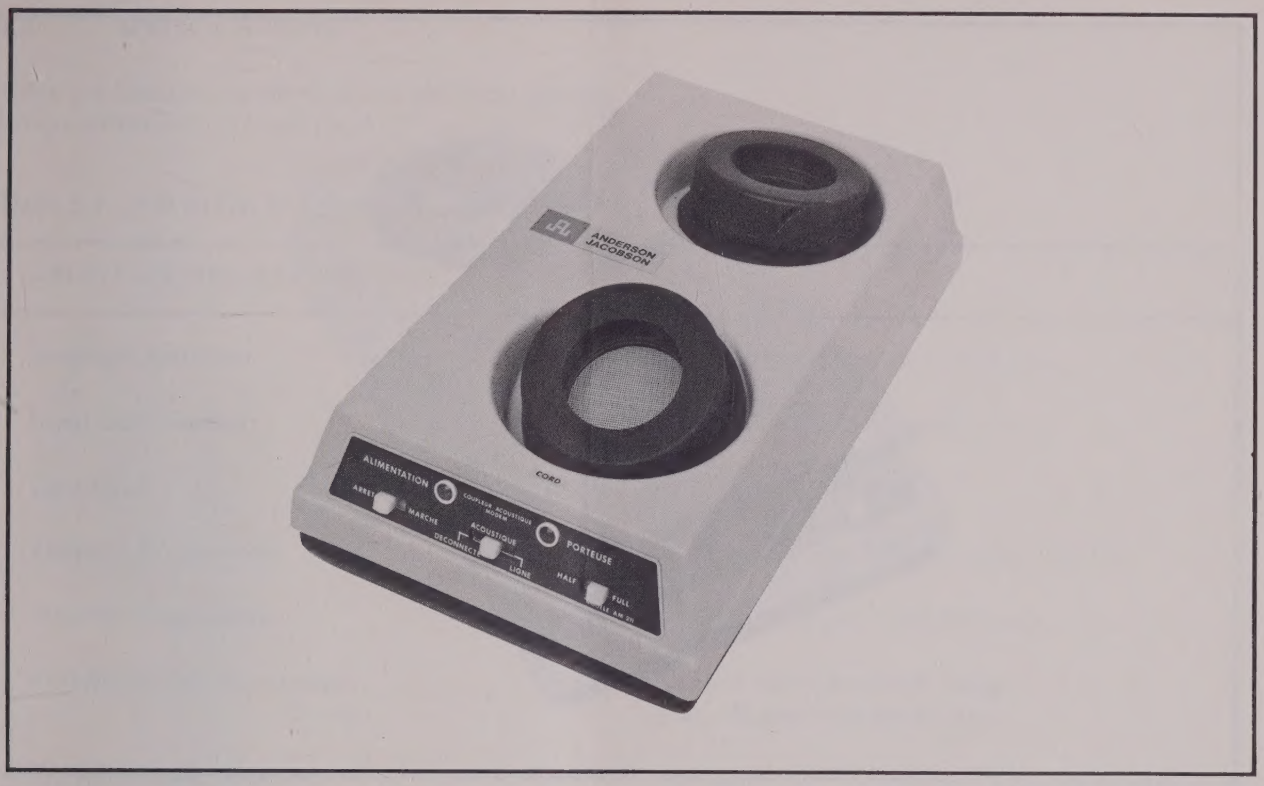


Figure 1-1. AM 211 Acoustic Coupler/Modem.

This manual provides information for an operator to install, operate and perform routine troubleshooting of Anderson Jacobson's AM 211 and A 211 Acoustic Couplers, which are compatible with equipment conforming to the Consultive Committee International Telegraph and Telephone (C.C.I.T.T.) specifications. The design is generally intended for use in European countries where C.C.I.T.T. specifications are in effect. Where regulations restrict usage of direct connect, as with G.P.O. in the United Kingdom, only the A 211 can be used.

The speaker and the microphone are mounted in the rubber cups on the AM 211 and A 211 top cover. These cups are designed to accomodate various types of telephone handsets in the world market. This means that handsets which differ because of spacing, diameter, and angle of mouth and ear pieces can fit the AM 211 and A 211 cups.

Troubleshooting or maintenance problems beyond those discussed in Section 5 require specialized test facilities and should be referred to the nearest AJ Service Center. Contact the nearest AJ Sales/Service office for further information.

1.1 DESCRIPTION

Figure 1-1 shows the AM 211, an originate mode acoustic coupler/modem. Figure 1-2 shows the A 211, an originate mode acoustic coupler. Both meet C.C.I.T.T. specifications and are designed to enable data terminals to communicate with other terminals and computers over public telephone networks. They are intended for use with keyboard terminals, and other terminals such as tape recorders, plotters, or CRT displays, which are designed to meet C.C.I.T.T. interface specifications.

Both the AM 211 and A 211 are originate-only devices which can exchange data only with an answer unit (generally a modem at a timeshare computer facility). The couplers permit acoustic and, in the case of the AM 211, also direct connection to the phone line for either half or full duplex data communications at data rates of up to 300 baud.

In data transmission, terminal data in serial binary form is used to modulate the coupler transmitter, which employs frequency-shift keying (FSK). The modulated carrier is then put onto the telephone

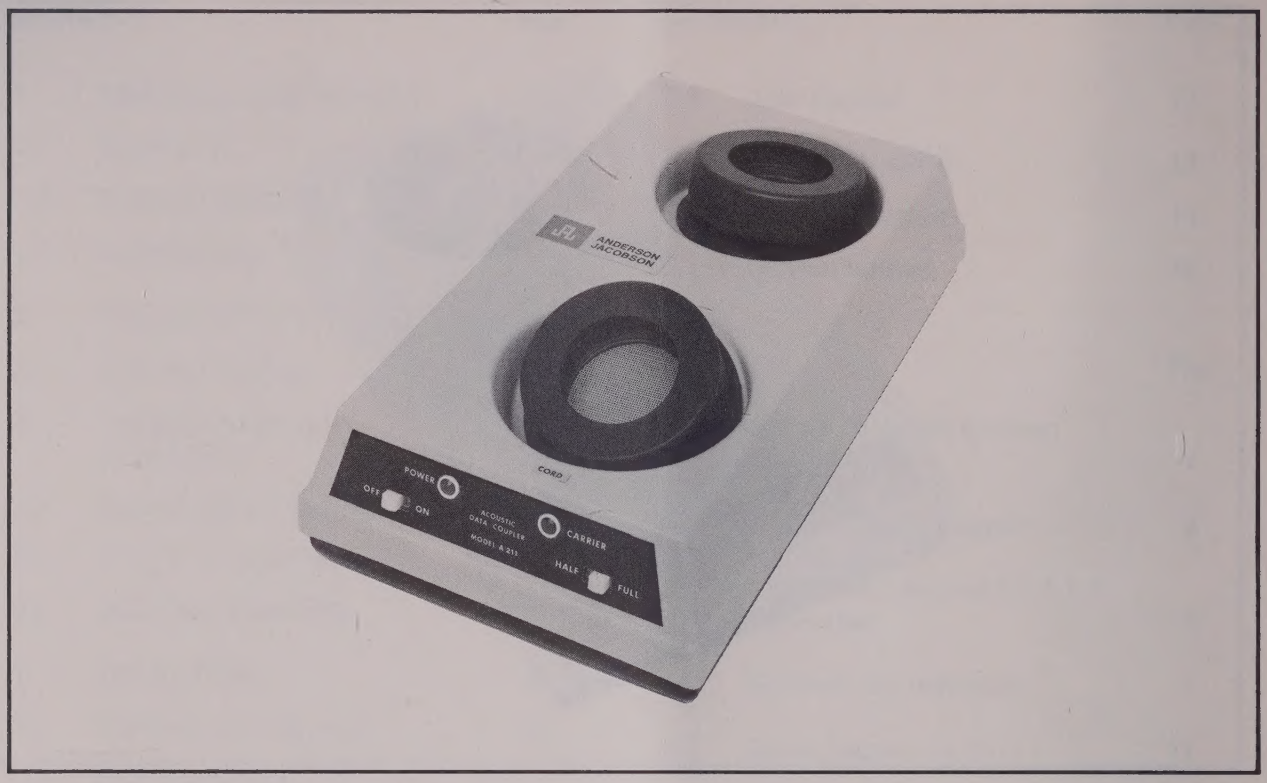


Figure 1-2. A 211 Acoustic Coupler

network, and the FSK signal is received and demodulated at the other end of the line to recover the original transmitted data and to generate computer response. Conversely, a modulated carrier signal from the computer is received by the coupler and converted into binary data for control and operation of the terminal. The coupling of the signals to the telephone line is accomplished by an acoustic coupling or direct wire connection. Since the modem is asynchronous, any data rate from 0 to 300 baud is usable.

1.2 MODES OF OPERATION

The AM 211 and A 211 modes of operation are described briefly in the following sections.

1.2.1 Acoustic Modes. In the acoustic mode of operation, the data link between the terminals is established by the operator calling the computer service on the telephone network. When an answering tone is heard, the operator simply places the handset into the acoustic cups of the coupler and the exchange of data between the local and remote terminals can proceed after the CARRIER lamp is lit.

1.2.2 Direct Mode (AM 211 only). In the direct connected mode of operation, the operator begins to establish two-way communication as in the acoustic mode. When the operator receives the answering tone, the front panel switch (DECONNECTE/ACOUSTIQUE/LIGNE) is used to transfer the telephone line from the telephone set to the modem. Move the switch momentarily to LIGNE and return the handset to its cradle. Data transmission proceeds by the direct coupling of the AM 211 to the telephone line through an isolation transformer. Section 4 contains additional detail on direct mode operation. (Note that abort timer, loss of carrier, and switch operation to DECONNECTE will drop telephone line and reconnect telephone set).

1.2.3 Half and Full Duplex. Either the half or full duplex operation is possible with these couplers. In full duplex operation, the transmitter and receiver can operate independently and simultaneously. In originate mode, the carrier must be on to activate the transmitter. In half duplex, only one signal (transmit or receive) can flow over the line at any given time. Data transmitted in half duplex will be printed at the sending terminal for verification.

1.3 SPECIFICATIONS

Table 1-1 contains the physical and electrical specifications of the AM 211 and the A 211.

Table 1-1. AM 211/A 211 Specifications

AM 211 SPECIFICATIONS	
Mode of Operation:	Originate Only; Half or Full Duplex
Input Data Format:	Serial Binary; Asynchronous
Data Rate:	0 to 300 baud
Transmit Frequencies	980 Hz Mark and 1180 Hz Space (±0.2%)
Receive Frequencies:	1650 Hz Mark and 1850 Hz Space
Receive Sensitivity, Acoustic: Direct:	-3 to -45 dBm (minimum range) -3 to -50 dBm (minimum range)
Transmit Level, Acoustic: Direct:	-18 dBm -3, -9, or -12±2* dBm (internally switch selectable)
Input Impedance: (direct connection)	AC: 600 ohms DC: 80, 180, 280, 380, 480, 580, or 680* ohms (internally switch selectable)
Modulation Technique:	Frequency-shift Keying (FSK)
Carrier Detect Delay (Typical)	1.5 seconds, Turn-on 125 milliseconds, Turn-off
Loss of Carrier Disconnect; Direct	5 seconds (Typical)
Abort Timer Disconnect; Direct	20 seconds (Typical)
Terminal Interface:	C.C.I.T.T.
Power Input:	190 to 150 Vac, 50/60 Hz, 1/8 amp Slo-blo (ASB) fuse
Size:	12.5 X 7.5 X 4.25 inches (32 X 19 X 11 cm)
Weight:	5 lb (2.3 kg)

Table 1-1. (Continued)

Indicator Lamps	ALIMENTATION and PORTEUSE
Switches:	DECONNECTE/ACOUSTIQUE/LIGNE ARRET/MARCHE and HALF/FULL

Note:

The AM 211 rubber cups are designed to accomodate a wide variety of handsets varying in spacing, diameter, and angles.

* Factory setting

A 211 SPECIFICATIONS

Mode of Operation:	Originate Only; Half or Full Duplex
Input Data Format:	Serial Binary; Asynchronous
Data Rate:	0 to 300 baud
Transmit Frequencies:	980 Hz Mark and 1180 Hz Space (±0.2%)
Receive Frequencies:	1650 Hz Mark and 1850 Hz Space
Receive Sensitivity, Acoustic:	-3 to -45 dBm minimum range (telephone line level)
Transmit Level Acoustic:	-18 dBm (telephone line level)
Modulation Technique:	Frequency-shift Keying (FSK)
Carrier Detect Delay (Typical):	1.5 seconds, Turn-on 125 milliseconds, Turn-off
Terminal Interface:	C.C.I.T.T.
Power Input:	190 to 250 Vac, 50/60 Hz, 1/8 amp Slo-blo (ASB) fuse
Size:	12.5 X 7.5 X 4.25 inches (32 X 19 X 11 cm)
Weight:	4.5 lb (2 kg)
Indicator Lamps:	POWER and CARRIER
Switches:	OFF/ON and HALF/FULL

Note:

The A 211 rubber cups are designed to accomodate a wide variety of handsets varying in spacing, diameters and angles.

The AM 211 and A 211 are designed for table or desk-top operation. Installation procedures consist of the simple cable connections described in the following sections. Figure 2-1 shows the location of the TELEPHONE, LINE and C.C.I.T.T. connectors on the rear panel of the AM 211. A C.C.I.T.T. connector is also shown on the rear panel of the A 211.

2.1 ACOUSTIC INTERFACE

The AM 211 and A 211 are equipped with universal cups which are adjustable to any handset size. These cups have an expanding lip and tilted mounting which enable adjustable spacing. To adjust the cup setting, check Table 2-1 and rotate both cups until the arrows on the cover are pointing to the correct number on the lip edge. Rotate the cups by firmly twisting the cups in the desired direction. Rotational movement is not easy, to prevent change in adjustment during use. Note: Do not rotate beyond the numbers; i.e., no rotation more than 180° is required. The mouthpiece and earpiece should be approximately centered when fully seated.

Table 2-1. Cup Settings.

Cup Settings	
Country or Company	Position
United States	0 ----- 0
England (Type 700)	4 ----- 4
France (New-S63)	3 ----- 3
France (Old-U43)	8 ----- 8
Erickson	0 ----- 0

2.2 TELEPHONE AND LINE CONNECTIONS (For AM 211 only)

When direct coupling mode is required, the TELEPHONE and LINE connections on the back of the coupler must be made in the following manner. (See Figure 2-1). A two-wire cable with terminal lugs on both ends (Model C 40) is used for connecting the unit for direct mode operation. When only acoustic coupling operation is used, these connections are not required.

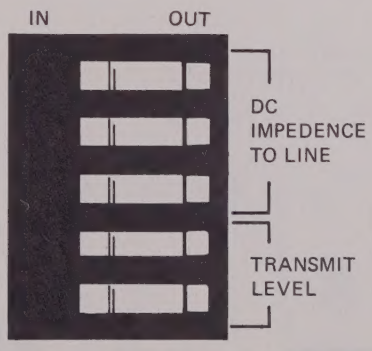
1. If the telephone and line cable have standard terminal lugs, install them. Otherwise, strip the insulation from the ends of the cable pairs so that bare wire can be wrapped around the coupler terminal posts.
2. Loosen the slotted terminal screws on the terminal strip on the back of the coupler.
3. Attach one wire of the telephone line pair to each post labeled LINE and tighten the screws.
4. In the same manner, attach the telephone set pair or wires to the terminal posts labeled TELEPHONE.
5. Recheck all terminal screws for tightness and inspect the connections to insure that cable ends are not shorted together (touching each other).

2.3 INTERNAL SWITCH SETTINGS (AM 211 in direct mode only)

The factory settings for these switches commonly satisfy the requirements and no new settings are required. To check and set the internal switch settings:

1. Remove the cover from the coupler by unscrewing the two Phillips screws on the rear panel.

2. Locate the five levered switch on the PC board.



2A. Three of these switches determine the amount (in steps of 100Ω) of d.c. resistances to be added in series to control the amount of dc current flowing in the loop. These

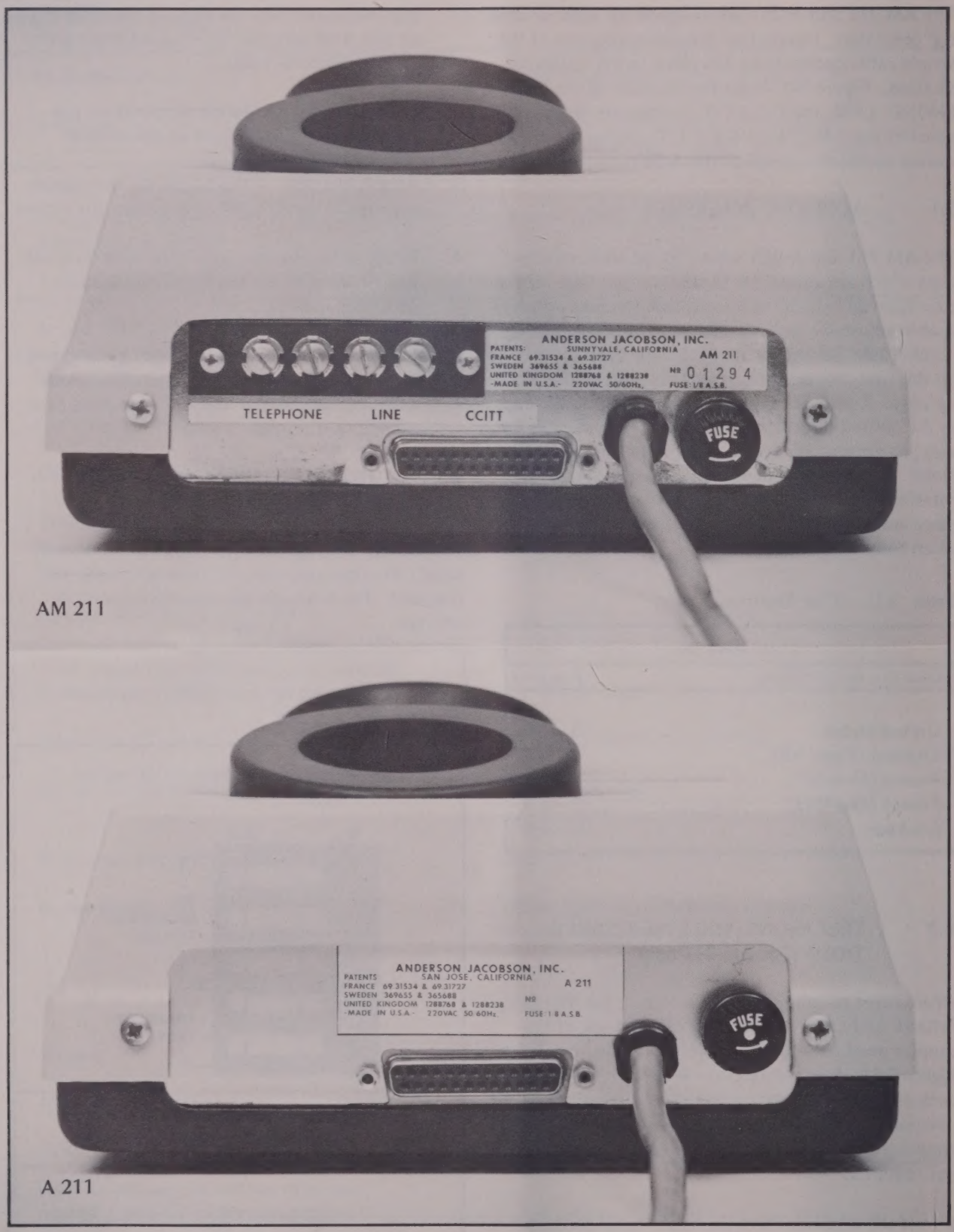
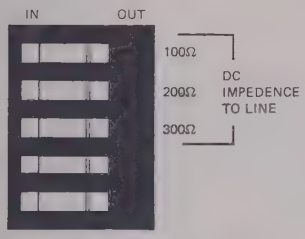


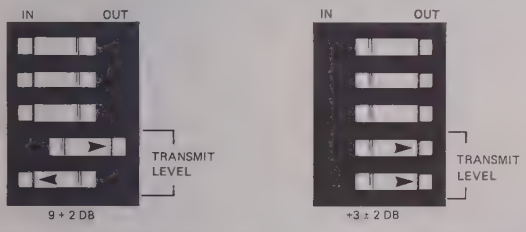
Figure 2-1. Telephone, Line and C.C.I.T.T. Connectors

(2A. Continued)

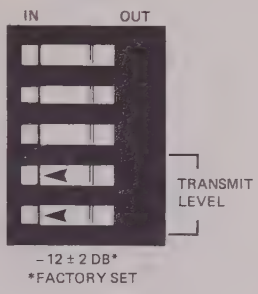
switches are factory set to add maximum dc resistance of 600Ω in series with the line. It may be desired to lower the dc resistance to be added to the line if the telephone set is quite far from the central office.



2B. To adjust the Transmit Level, first check the requirements for the transmit level at the installed location. Adjust the switches to satisfy the DB level requirement as shown below.



(2B. Continued)



2.4 C.C.I.T.T. CONNECTION

The terminal equipment's connector cable is plugged into the 25 pin connector on the back of the modem. This connector is labeled CCITT. Figure 2-2 diagrams the C.C.I.T.T. terminal coupler interface of both the AM 211 and the A 211. It also indicates the pin connections and their functions.

2.5 AC POWER CONNECTION

The AM 211 and the A 211 couplers are equipped with a 3-wire power cord and a plug which can be connected to a 2-wire or 3-wire, 220 Vac, 50/60 Hz receptacle. The input power feeds into each unit through a .125A, slow-blow fuse which is located on the rear panel. As soon as the line cord has been connected to a power outlet, the coupler is ready for operation.

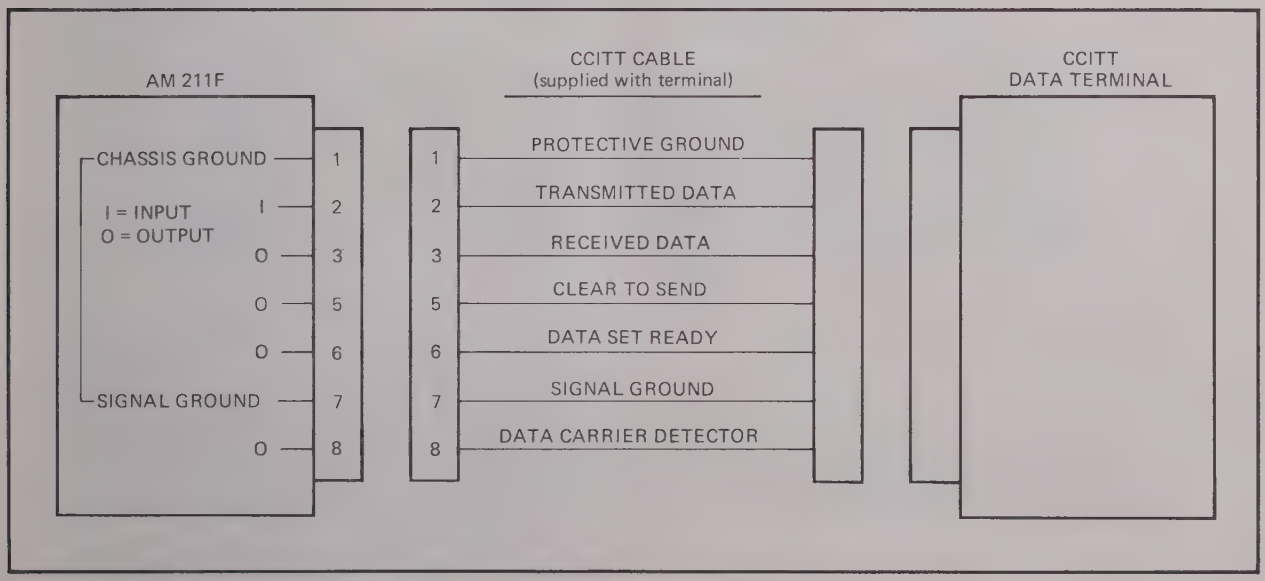


Figure 2-2. C.C.I.T.T. Terminal/Coupler Interface (515A)

OPERATION 3

This section provides the operator with specific instructions in the form of information on controls and indicators, procedures for establishing data link communications, and a discussion of operational considerations.

3.1 CONTROLS AND INDICATORS

The following functional descriptions apply to the coupler controls and indicators illustrated in Figure 3-1.

OFF (ARRET)/ON (MARCHE): This 2-position switch controls the ac power supply to the unit.

POWER (ALIMENTATION): This red indicator glows when the power switch is in ON position, indicating power is applied to the unit.

CARRIER (PORTEUSE): This green indicator glows when a valid carrier signal is received from the telephone line.

HALF/FULL: This 2-position switch selects half or full duplex operation of the coupler.

ACOUSTIQUE/DECONNECTE/LIGNE: This 3-position switch is spring loaded in the center, ACOUSTIQUE, position. In this position, the telephone line remains connected to the telephone set for acoustic operation. Momentary operation of the switch to LIGNE causes the transfer of the telephone line from the telephone set to the modem line input. Momentary operation of the switch to DECONNECTE immediately restores the normal telephone set to telephone line connection. If the telephone line connection is not made because only acoustic operation is required, do not operate the switch. If it is moved to LIGNE, acoustic signals will be inhibited for about 20 seconds. If it is moved to DECONNECTE, there will be no effect on acoustic operation.

3.2 DATA CONNECTION ESTABLISHMENT

A typical data link between a local terminal and remote computer is established as follows:

1. Set the power switch to ON and observe the red POWER light come on.

2. Set the HALF/FULL duplex switch according to computer service requirements.

   Note: The selection of half or full duplex operation is often dictated by the computer service or other remote station. The required switch position is usually noted in the operator's manual for the computer or checklist for the station. If not, the operator selects the duplex mode best suited to his requirements. Half duplex may be used when a copy of the data transmission is required. Some full duplex systems echo transmitted data back for verification, making the terminal appear to be operating in half duplex when it is not.

3. Dial the computer service and get an answering tone in the earpiece of the handset.

4. Put the handset into the acoustic cups by firmly inserting the mouthpiece first and then the earpiece into the other cup.

   4A. (AM 211 direct mode use only) Alternatively, operate the 3-position switch momentarily to LIGNE (modem operation) and return the handset to its cradle if direct wire connection is to be used.

   Note: Receiver sensitivity is greater in direct mode than in acoustic; therefore, operation in direct mode provides more reliable coupling to the telephone line in locations where acoustic coupling may be marginal or erratic due to the telephone system or the characteristics of the telephone set and handset.

5. Observe the green CARRIER light come on, indicating a valid carrier signal.

6. Sign on with the computer and transmit the data message.

Terminate the data link by signing off in the manner prescribed by the computer service, switching coupler power off, and returning the telephone handset to its cradle (presuming acoustic mode has been in use). The telephone handset comes out of the rubber cups easily if rolled to the side and taken out.

The AM 211 design provides failsafe operation in the direct mode. Any equipment malfunction which results in a loss of carrier automatically reconnects

the telephone set for normal operation in the telephone line network. The manual disconnect option provides further flexibility, permitting an operator immediate use of the telephone set in an emergency situation or to interrupt an obviously unresponsive or erroneous transmission.

Figure 3-1. Controls and Indicators.

4 THEORY OF OPERATION

This section describes both the general theory of A 211 operation as an acoustic coupler and AM 211 operation as an acoustic coupler or modem. The discussion is based on the two block diagrams (Figures 4-1 and 4-2). These block diagrams are divided into sections and each of these sections is further divided into functionally related blocks which operate on incoming data and signals to generate the unit outputs.

4.1 RECEIVER

The receiver is designed to demodulate the incoming FSK signal, converting it into the original mark and space message.

The acoustic or direct line inputs activate the receiver through connecting circuitry. When direct line (AM 211 only) mode is selected by operation of the front panel switch, signals and noise from the acoustic input are inhibited. These inputs are amplified by the amplifier before being sent to the bandpass filter; the voltage gain provided by this amplifier is less when the input is directly from the microphone.

A four stage analog bandpass filter removes out-of-band noise from the amplifier to improve the signal-to-noise ratio. It provides more than 45 dB rejection of frequencies in the lower frequency data band.

The output of the bandpass filter is amplified and limited to produce a symmetrical square wave, which is nearly constant for any amplitude of input signal within the specified range. The limiter output is fed to the delay and pulse shaping circuits which generate pulses for use in the digital carrier detector and discriminator.

A crystal controlled oscillator circuit provides basic timing for the receiver and transmitter. The oscillator uses a series resonant crystal and a TTL hex-gate to generate a stable square wave clock. The receiver uses the clock to provide precise pulse widths for demodulation of the received carrier. All digital timing requirements are derived from this clock.

A digital carrier detector and discriminator includes a frequency window detector which uses full cycle detection to determine if the received signals are in or out-of-band. A flip-flop is set in the event that the received signals are in-band. If it is not within the window, the incoming frequency is out-of-band and the flip-flop is reset. Since this decision is based on frequency information, this digital detection is more able to distinguish a valid carrier signal, and it will not respond even to large amplitude out-of-band frequencies which are received. The flip-flop output drives the carrier detector delay and output.

The carrier detector delay circuit integrates the waveform and produces a digital output indicating the presence or absence of a valid carrier. Proper delays are obtained during the "handshaking process" so that only in-band data will keep the carrier detector on. The turn on time is typically 1.5 seconds; if the carrier is lost, the output of the carrier delay circuit will go low in 125 milliseconds.

The outputs of the carrier detector delay circuit provide Carrier Detector and Clear-to-Send interface signals to the local terminal, activate the carrier detector lamp, and enable the data output circuit. They also enable the transmitter output and provide a logic signal to the telephone line control circuitry.

The digital discriminator portion of the carrier detector and discriminator block produces an input to the data filter and slicer which is a waveform varying in duty cycle according to the input frequency. The data filter and slicer circuit provides Mark and Space levels to the data output terminal. In half duplex operation, transmitted data levels also drive the data output circuits; thus, the local terminal prints out the message it transmits.

4.2 TRANSMITTER

The transmitter section converts the terminal message in serial binary form to a modulated carrier for transmission on the telephone network via acoustic or direct (AM 211 only) coupling.

The output of the crystal oscillator circuit is divided in the frequency dividers, and the resulting clock is the reference frequency fed into transmitter frequency control. This input clock is further divided depending on whether the terminal transmitted data is Mark or Space.

When enabled by the input from the receiver section, the digital smoothing circuit divides the gated logic

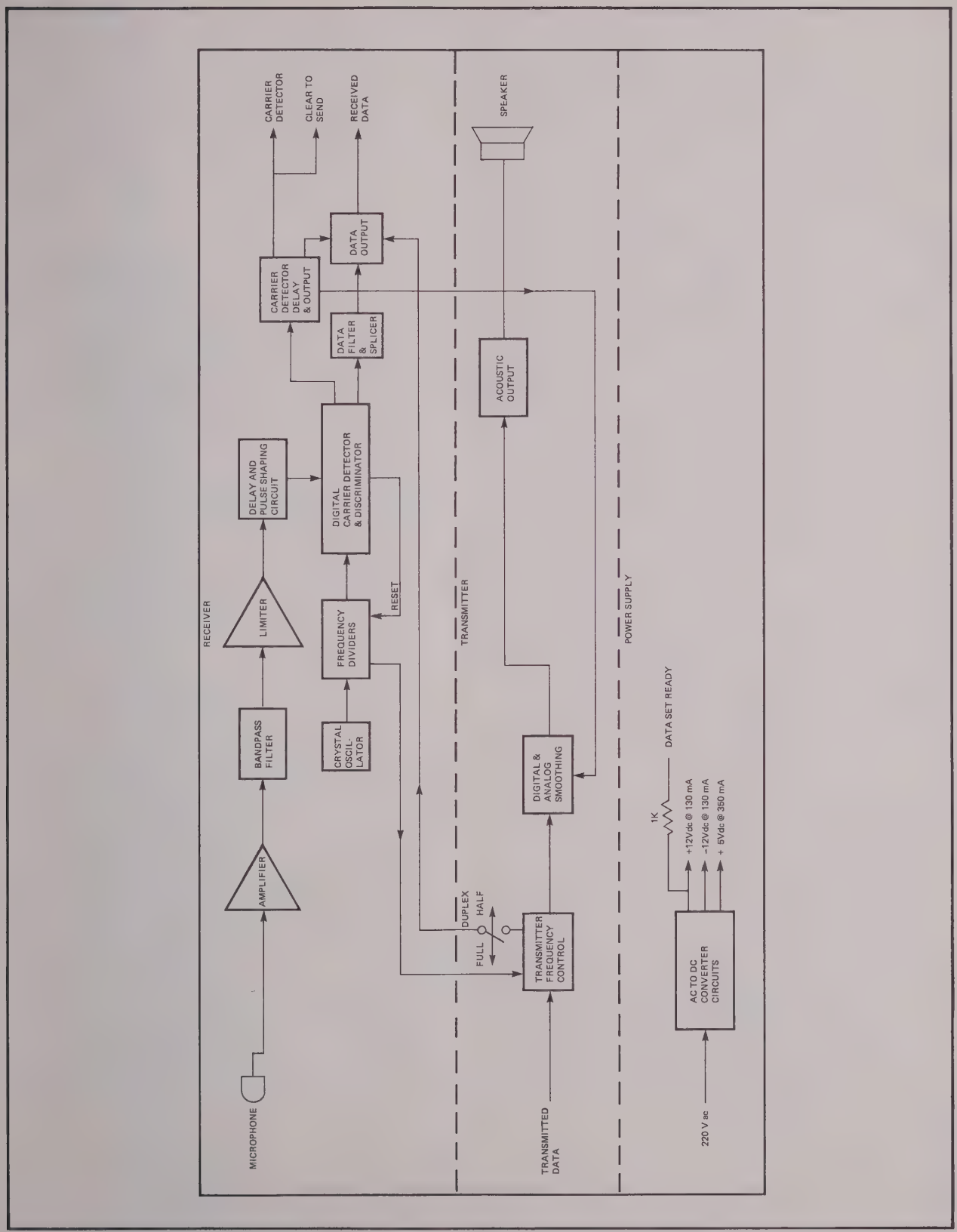


Figure 4-1. Block Diagram (A 211).

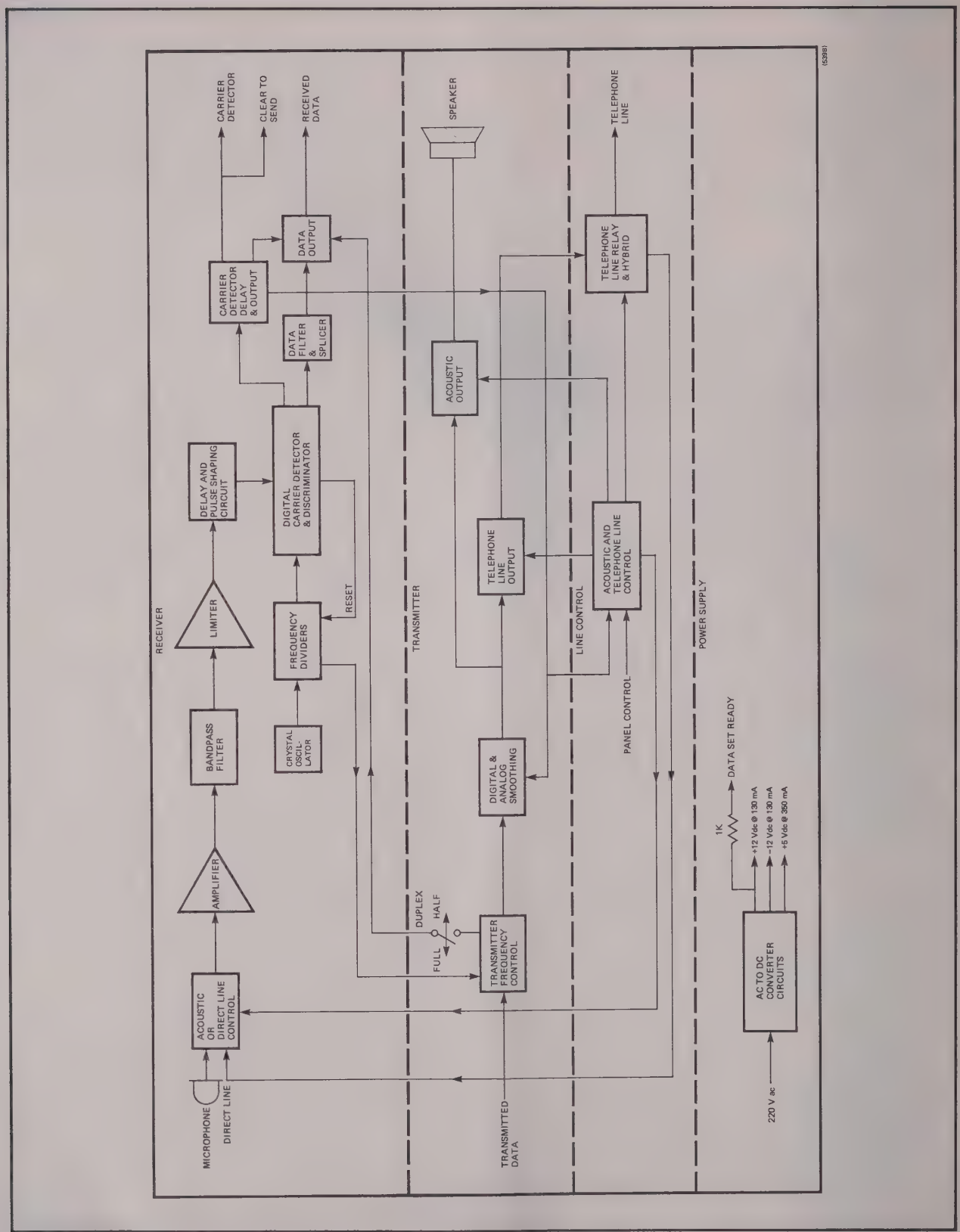


Figure 4-2. Block Diagram (AM 211).

input to yield transmitted square wave frequencies of 980 Hz for Mark and 1180 Hz for Space. This final division eliminates even harmonics in the square waves, and smooths the transitions from Mark to Space and Space to Mark, resulting in less phase jitter at the remote receiver. The digital output is further filtered by a low pass filter to remove higher frequency components in the transmitted carrier.

Depending on the mode of operation for the AM 211, the filtered carrier (to be transmitted) feeds to the acoustic output circuit or to the telephone line output circuit. When operating in direct mode, the acoustic output is inhibited, and when operating in acoustic mode, telephone line output is inhibited. In the case of the A 211, the transmitter carrier always drives the speaker for acoustic coupling.

The telephone line output driver (AM 211 only) consists of a voltage amplifier with variable voltage gain which can be set by internal switches to three selectable voltage levels. There is also a hybrid circuit with a balance control used to reduce the level of transmitted signal which is fed to the receiver station.

4.3 POWER SUPPLY

The power supply section receives an ac input, rectifies it, and supplies both regulated and unregulated dc power to various electronic circuits within the unit. Input power of 220 ± 30 Vac feeds into the unit through a three-wire line cord and 1/8 A slow-blow fuse (ASB) fuse. A step-down power transformer steps down the primary voltage. The secondary winding has a tap to provide two ac voltages; one is fed to two half-wave rectifiers and capacitor filters to generate + 12 and −12 Vdc; in a similar circuit, the other ac voltage generates +9 Vdc. The +9 Vdc is unregulated and supplies the +5 Vdc regulator circuit. The Data Set Ready signal to the local terminal is provided by a 1000 Ω resistor to the +12 Vdc power source.

4.4 LINE CONTROL (AM 211 only)

This switch controls whether the AM 211 is used in the acoustic or direct mode and provides for automatic or manual disconnect of direct mode operation in order to restore normal telephone set connections. Sections 3.1 and 3.2 describe the controls and operating procedures for each mode.

The AM 211 normal configuration is for acoustic coupling. When it is used in the direct mode, the operator, upon hearing the carrier tone in the handset earpiece, slides the spring loaded selector switch to LIGNE. This activates a relay (make-before-break type, form D contacts) in the telephone line relay and hybrid circuits and isolates the telephone set from the telephone line. With the make-before-break type relay, the dc exchange connection is maintained continuously while switching the telephone line from the telephone set to the modem. Simultaneously the telephone line is connected to the modem through an isolation transformer. The transformer provides separation of dc line current and the ac signals. The modem input circuits incorporate protection from impulse voltages on the line resulting from climatic or man-made conditions. Three switch-selectable resistors in the telephone line input circuit permit adjustment of dc line current to the desired level. The range of dc input resistance is 80 to 680 Ω in 100 Ω increments. The ac input impedence is 600 Ω.

Once the panel switch has been operated momentarily to LIGNE, the modem must detect a carrier signal within 20 seconds; otherwise the relay is de-energized and the usual telephone set connection to the telephone line is re-established. This automatic disconnect is achieved in the acoustic and telephone line control block. If the carrier is lost after two-way communication is established, the relay will be de-energized and restore the normal telephone set connection in five seconds. It is also possible to restore the normal connection immediately by operation of the momentary switch to the DECONNECTE position.

MAINTENANCE 5

Both the AM 211 and the A 211 are designed for long, trouble-free usage. The circuitry is all solid-state. AJ's rigid quality control, thorough testing, and conservatively rated components afford maximum reliability; thus no regular maintenance program is necessary. If a malfunction is suspected, the procedures below will isolate the problem quickly and will enable the operator to determine whether or not a service call is required.

5.1 TROUBLE DIAGNOSIS

If the coupler does not work properly, make these checks:

* IS THE RED POWER LIGHT ON? Check to see that the coupler is plugged into an active ac outlet and the power switch is ON. Check the coupler fuse on the rear panel to see that it is good (the metal strip inside the fuse is intact).

* IS THE GREEN CARRIER LIGHT ON? Acoustic mode: Listen to the telephone handset for the carrier tone. Ensure the handset is oriented and seated properly in the acoustic cups: i.e., the handset cord is on the same side as the label CORD. Check that tone stays on long enough to activate CARRIER light.

  Modem (direct) mode (AM 211 Only): The loss of carrier for more than five seconds automatically reconnects the telephone set to the telephone line, but at the same time, the connection to the computer has been broken. Call the computer service to re-establish the data link connection. Check switch and relay circuit by listening to carrier tone in earpiece after momentary operation of switch to LIGNE. If the tone continues, the telephone set is not being disconnected, indicating a bad switch or relay circuit.

* ARE THE INTERFACE CABLES CONNECTED CORRECTLY? See Figure 2-2 for correct connections. Be sure correct terminal cable is in use. Check telephone line and telephone set connections to the coupler for tightness.

* IS THE DUPLEX SWITCH IN CORRECT POSITION? Check the operator's checklist for the remote station and/or the manual of the computer service or data system being used.

* IS THE DATA TERMINAL COMPATIBLE WITH THE COMPUTER SERVICE OR DATA SYSTEM BEING USED? Check the operator's manual of the terminal and the service to ensure that the same character code and data rate are being used for both. Make sure the data rate being used is within the coupler's range of 0 to 300 baud.

* IS THE COMPUTER SERVICE IN OPERATION? Check the operator's manual for the hours of the computer. Call the service to ensure they are operating as scheduled. Check operation with another service.

5.2 SERVICE SUPPORT

If the trouble is not solved by any of the above checks, call the nearest AJ Sales/Service Office. There, trained personnel familiar with couplers, terminals, and computer timesharing will be able to suggest further testing, give verbal diagnosis of a fault somewhere in the system, or suggest return of the coupler for repair. If the coupler is within warranty, no charge will be made. Otherwise charges are made on a time and material basis plus transportation.

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